TITLE

METHOD AND SYSTEM OF IMPLEMENTING REAL-TIME VIDEO-AUDIO INTERACTION BY DATA SYNCHRONIZATION

BACKGROUND OF THE INVENTION

5   **Field of the Invention**

The present invention relates to a real-time video-audio interaction technology and in particular to a method of implementing real-time video-audio interaction by data synchronization in an Internet

10 game.

Description of the Related Art

Generally speaking, the system architecture of an Internet game comprises an Internet game server and Internet game clients.   The Internet game server

15 receives and processes data from the Internet game clients to execute the Internet game.   The Internet game clients interact with other Internet game clients and the Internet game.   In other words, all the data required by the Internet game is sent to the Internet

20 game server for data processing and data operation. Real-time video-audio interaction utilizes a camera and microphones in an Internet game client to retrieve the real-time data and transmit the retrieved data through the Internet to other Internet game clients

25 for interaction.

Three main technological difficulties limit Internet game systems' support of real-time video-audio interaction. First, current video display technology in an Internet game cannot display a real-

5 time video picture if 3D animation occupies the display. Second, if the compression and transmission of video and audio data are executed solely in the Internet game server, the server becomes overloaded and bandwidth is compromised, affecting the speed of

10 the Internet game. Third, the degree of video and audio data synchronization affects the result in real-time interaction. Hence, presently, real-time video-audio interaction is not supported in an Internet game.

15   **SUMMARY OF THE INVENTION**

Accordingly, an object of the invention is to provide a method of establishing an Internet transmission channel between Internet game clients, compressing and packaging real-time video-audio data

20 in the Internet game clients, and transmitting the packaged data to other Internet game clients. The Internet game client that receives the transmission package, i.e. the recipient Internet game client, decodes the transmission package and applies a module

25 simultaneously supporting real-time video and 3D animation to display the real-time video data when 3D animation occupies the display in an Internet game. In addition, the recipient Internet game client utilizes a sound card, cooperating with audio input or

output, to output the real-time audio data back. The module simultaneously supporting real-time video and 3D animation outputs the real-time video data by integrating the real-time video data into game

5 environments of the Internet game as texture mapping, accomplishing simultaneous display.

To achieve the foregoing and other objects, the invention overcomes conventional real-time data interaction problems in an Internet game. In one

10 embodiment, the inventive method first establishes an Internet transmission channel between sender and recipient Internet game clients, without first connecting to an Internet game server. Next, the Internet game clients execute the Internet game and

15 connect to the Internet game server.

Then, real-time video and audio data are retrieved by the sender Internet game client, which then compresses/encodes the retrieved real-time video data into video data frames, compresses/encodes the

20 real-time audio data into audio data packets, packaging both into a transmission package. The transmission package is then transmitted to the recipient Internet game client through the Internet transmission channel. A time stamp is attached in the

25 transmission package for synchronizing the video and audio data.

Finally, the recipient Internet game client decodes the transmission package into real-time video and audio data. The recipient Internet game client

30 synchronizes the real-time video and audio data

according to the time stamp, outputs the decoded real-time video data in game environments, and outputs the decoded real-time audio data, achieving real-time video-audio interaction in the Internet game.

5   **BRIEF DESCRIPTION OF THE DRAWINGS**

The present invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

10   Fig. 1 is a flowchart of the method of implementing real-time video-audio interaction by data synchronization in an Internet game.

Fig. 2 is a diagram of the system of implementing real-time video-audio interaction by data

15   synchronization in an Internet game.

Fig. 3 is a detailed diagram of the system of implementing real-time video-audio interaction by data synchronization in an Internet game.

Fig. 4a, Fig. 4b are diagrams of the method of

20   implementing real-time video-audio interaction by data synchronization in an Internet game.

DETAILED DESCRIPTION OF THE INVENTION

As summarized above, the present invention provides a system and method overcoming conventional

25   real-time data interaction problems in an Internet game, first establishing an Internet transmission channel between Internet game clients without first connecting to an Internet game server. Next the

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Internet game clients execute the Internet game and
connect to the Internet game server.

The Internet transmission channel is established
as follows. First, the sender Internet game client
5 assigns an Internet address of a recipient Internet
game client directly or according to a directory which
may include all the Internet addresses of possible
recipient Internet game clients. The sender Internet
game client then transmits a connection request to the
10 recipient Internet game client. The recipient
Internet game client establishes the Internet
transmission channel in response to the connection
request.

Real-time video and audio data are retrieved in
15 the sender Internet game client, which then
compresses/encodes the retrieved real-time video data
into video data frames, the real-time audio data into
audio data packets, packaging both into a transmission
package. The transmission package is then transmitted
20 to the recipient Internet game client through the
Internet transmission channel.

If the bandwidth of the Internet transmission
channel is not sufficient to transmit the real-time
video and audio data, the real-time audio data takes
25 priority over real-time video data. The advantage of
considering audio data first is that audio data can be
highly compressed. Thus, even if the bandwidth of the
internet transmission channel is seriously deficient,
the smooth of real-time audio data can be maintained,

achieving the basic requirement of real-time interaction.

Finally, the recipient Internet game client decodes the transmission package into real-time video
5 and audio data. The recipient Internet game client synchronizes the real-time video and audio data according to the time stamp, outputs the decoded real-time video and audio data in game environments.

One important concern of video-audio data
10 synchronization is maintaining correct time information for data display. If an Internet game client retrieves and displays real-time video-audio data, data synchronization is not a problem because the display time is synchronized to the system time of
15 the Internet game client. If the Internet game client that retrieves real-time data is different from the display client, then the display client has to add the system time and the time stamp together as the display time.

20 Conversely, because the transmission package considers the audio data first, there may be fewer transmitted video data frames than originally retrieved video data frames. The decompression of the transmission package may also drop some video data
25 frames because of the data compression reference (IPB). Thus, the mentioned time stamp and the amount of real-time video data must be applied to drop video data frames to achieve the expected result of video-audio data synchronization. The data synchronization

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can be processed before or after the video-audio data
decompressing/decoding.

Further, the invention provides a system of
implementing real-time video-audio interaction by data
5   synchronization in an Internet game.   The inventive
system includes an Internet game server and Internet
game clients.   The Internet game server executes an
Internet game main program.   The Internet game clients
comprise interactive Internet game clients and an
10 Internet transmission channel.   The Internet game
clients connect to the Internet game server, and the
Internet transmission channel connects to the
interactive Internet game clients, i.e. the sender and
recipient Internet game clients.

15   The sender Internet game client has a real-time
data retriever, data encoder, transmission packager,
and Internet sender.   The real-time data retriever
retrieves real-time video and audio data from the
Internet   game   client.   The   data   encoder
20 compresses/encodes the real-time video data into video
data frames, and the real-time audio data into audio
data packets.   The transmission packager then packages
the encoded video and audio data packets into a
transmission package.   A time stamp is attached to the
25 transmission   package.   The   time   stamp   enables
synchronization between the real-time video and audio
data.   The Internet sender transmits the transmission
package to the recipient Internet game client through
the Internet transmission channel.

Here, the Internet transmission channel is established according to the steps mentioned above. Again, if the bandwidth of the Internet transmission channel cannot accommodate the real-time audio and

5   video data simultaneously, the real-time audio data takes priority over the real-time video data.

The recipient Internet game client includes a data decoder and a video-audio playback system. The data decoder decodes the transmission package into

10   real-time video and audio data. The video-audio playback system outputs the decoded video and audio data according the time stamp attached to the transmission package. Similarly, the video-audio playback system integrates the decoded real-time video

15   data into game environments of the Internet game as texture mapping. The data is synchronized by adding the system time of the second internet game client and the time stamp together as the display time of the second real-time video and audio data. Data may also

20   be synchronized comparing the time stamp to the amount of the second real-time video data and the number of frames dropped from the second real-time video data.

Moreover, the invention provides a method of real-time video-audio interaction by data

25   synchronization in an Internet game for application in an Internet game client. The Internet game client first establishes an Internet transmission channel to an external Internet game client without connecting to the Internet game server. The Internet game client

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then connects to the Internet game server and executes
the Internet game.

Thereafter, real-time video and audio data are
retrieved by a real-time data retriever and
5 compressed/encoded into a transmission package.   A
time stamp is attached to the transmission package for
data synchronization.   The time stamp expresses the
synchronous relationship between the real-time video
and audio data.   The transmission package is
10 transmitted to the external Internet game client
through the Internet transmission channel.

The Internet transmission channel is established
by a specific procedure.   The Internet game client
assigns an Internet address to the external Internet
15 game client directly or according to a directory which
may include all the Internet addresses of possible
external Internet game clients.   The Internet game
client then transmits a connection request to the
external Internet game client.   The external Internet
20 game client establishes the Internet transmission
channel in response to the connection request.   If the
bandwidth of the Internet transmission channel cannot
support the real-time audio data and video data
simultaneously, the real-time audio data takes
25 priority over real-time video data.

The Internet game client receives a transmission
package from the external Internet game client through
the Internet transmission channel.   The Internet game
client decompresses/decodes the transmission package
30 into real-time video and audio data.   The Internet

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game client then synchronizes the decoded video and audio data according to the time stamp attached to the transmission package, and outputs the decoded audio and video data in the Internet game.

5   One embodiment of the invention is directed to a storage medium for storing a computer program, wherein the computer program, when applied to a computer system, implements real-time video and audio interaction by data synchronization between Internet

10   game clients.   The method may include the steps mentioned above.

Another embodiment is directed to a computer system of an Internet game, executing an Internet game and having a storage medium for storing a computer

15   program, wherein the computer program is applied to a computer system and implements real-time video-audio interaction by data synchronization between Internet game clients.   The method may include the steps mentioned above.

20   Fig. 1 is a flowchart of the method of implementing real-time video-audio interaction by data synchronization in an Internet game. The method first establishes an Internet transmission channel between clients without connecting to an Internet game server

25   (step S100). The Internet transmission channel can be established by any standard Internet transmission protocol, such as TCP/IP. The establishment of the Internet transmission channel is accomplished by certain steps. The sender Internet game client

30   assigns an Internet address to a recipient Internet

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game client directly or according to a directory which may include all Internet addresses of possible recipient Internet game clients. The sender Internet game client then transmits a connection request to the

5 recipient Internet game client. The recipient Internet game client establishes the Internet transmission channel in response to the connection request.

Next, the internet game clients connect to the

10 internet game server for executing the internet game (step S101). Real-time video and audio data are retrieved by the sender Internet game client (step S102). The real-time video data may be retrieved by a video capture device, such as a camera. The real-time

15 audio data may be retrieved by an audio capture device, such as a microphone.

The sender Internet game client then compresses/encodes the real-time video data into video data frames, and compresses/encodes the real-time

20 audio data into audio data packets (step S104). Compression can be accomplished by a standard data compression format, such as H.263, MPEG 1/2/4, or G723.

The video and audio data packets are then

25 packaged into a transmission package (step S106). Smooth audio data transmission and the synchronization between video and audio data are the chief concerns of the Internet real-time video-audio data transmission, therefore, the inventive method gives the highest

30 transmission priority to audio data in the

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transmission package, such that, if the bandwidth of
the Internet transmission channel cannot
simultaneously support the real-time video and audio
data transmission, the audio data takes priority over

5 video data. A time stamp is attached to the
transmission package for synchronizing the video and
audio data (step S107). The time stamp attached to
the transmission expresses the synchronous
relationship between the real-time video and audio

10 data, enabling synchronization between the real-time
video and audio data. Thus, the inventive method
guarantees smooth audio data transmission and accurate
synchronization of video and audio data.

      The transmission package is then transmitted to

15 the recipient Internet game client through the
Internet transmission channel (step S108). Finally,
the recipient Internet game client decodes the
transmission package into real-time video and audio
data (step S110), synchronizes the real-time video and

20 audio data according to the time stamp (step S111),
outputs the decoded real-time video data to the
Internet game environments, and outputs the decoded
real-time audio data (step S112). The real-time
interactive video data is integrated into the Internet

25 game environments as texture mapping, to be
simultaneously displayed in all the connected game
environments as real-time video data.

      The data synchronization in the step S111 may be
based on the system time of the second internet game

30 client, adding the time stamp, as display time of the

second real-time video and audio data.   The data
synchronization may base on the time stamp and refer
to the amount of the second real-time video data to
drop data frames of the second real-time video data.

5   Thus, fewer video frames will be displayed in a fixed
time period, that is, the display time of each video
data frame is prolonged to allow video and audio data
synchronization.

The data synchronization of the step S111 can be

10   processed before or after the step S110.   If the data
synchronization is processed before decoding, the
video data frames may be dropped after decoding due to
differences between decoders.   If the data
synchronization is processed after decoding, the

15   dropped video frames are known, thus the number of
dropped frames can be controlled.

Fig. 2 is a diagram of the system of real-time
video-audio interaction by data synchronization in an
Internet game of the invention.   In one embodiment,

20   the inventive system includes an Internet game server
20 and Internet game clients 24, 26, 28, 30.   The
Internet game server 20 executes an Internet game main
program.   The Internet game clients 24, 26, 28, 30,
include interactive Internet game clients 24, 26, and

25   an Internet transmission channel 32.   The Internet
game clients 24, 26, 28, 30, connect to the Internet
game server 20 to establish an Internet game network
22.   The Internet transmission channel 32 connects to
the interactive Internet game clients 24 and 26

30   without connecting to the Internet game server 20.

Fig. 3 is a detailed diagram of the system of real-time video-audio interaction by data synchronization in an Internet game. The sender Internet game client 300 has a real-time data

5 retriever 302, a data encoder 304, a transmission packager 306, and an Internet sender 308. The real-time data retriever 302 retrieves real-time video and audio data from the Internet game client 300. The real-time data retriever 302 may comprise separate

10 devices retrieving and processing video and audio data separately or an integrated device. The real-time data retriever 302 can be any data capture device, such as a camera or microphone.

The data encoder 304 compresses/encodes the real-

15 time video data into video data frames, and the real-time audio data into audio data packets. The data encoder 304 may comprise separate devices to compress/encode video and audio data separately or an integrated device.

20 The transmission packager 306 assigns the audio frames highest transmission priority and packages the video frames and audio data packets into a transmission package. A time stamp is attached to the transmission package. The time stamp expresses the

25 synchronous relationship between the video and audio data, that is, the time information of producing video and audio. The Internet sender 308 transmits the transmission package to the recipient Internet game client 320 through the Internet transmission channel

30 310. As an example, the transmission packager 306,

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the Internet sender 308, and the Internet transmission
channel 310 can be implemented by programming into
computer-executive modules in program languages to
achieve the operations described.

5   The recipient Internet game client 320 includes a
data decoder 322 and a video-audio playback system
324.   The data decoder 322 decodes the transmission
package into real-time video and audio data.   Here,
the data decoder 322 can comprise separate devices or
10   be an integrated device.   The data encoder 304 and the
data decoder 322 may be implemented by programming
into computer-executive modules in program languages
to achieve the mentioned functions.

          The video-audio playback system 324 synchronizes
15   the decoded video and audio data according to the
attached time stamp.   The video-audio playback system
324 integrates the decoded real-time video data into
game environment of the Internet game as texture
mapping.   The video-audio playback system 324 outputs
20   the real-time audio data by a sound card with audio
input or output.   The real-time video-audio
interaction between the Internet game clients is bi-
directional, that is, the Internet game clients for
real-time video-audio interaction are provided with
25   both sender and recipient functions.   All components
and functions of both sender and recipient are
provided in the sender Internet game client 300 and
the recipient Internet game client 320.

          Figs. 4a, Fig. 4b are diagrams of the method of
30   implementing real-time video-audio interaction by data

synchronization in an Internet game. An Internet transmission channel 50 is established for transmission. The camera 40 retrieves real-time video data and microphone 42 retrieves real-time audio data.

5   The data encoder 44, 46, compresses/encodes the real-time video data into video data frames, 440, 442, 444, 446, P frames. The data encoder 44, 46, also compresses/encodes the real-time audio data into audio data packets 460, 462, 464, L packets. The audio data

10   packet takes priority over the video data frames. The video data frames and audio data packets are packaged into a transmission package 48. In other words, the audio data frame 460 is packaged first into the transmission package in one fixed time period and the

15   video data frames 440, 442 are then packaged according to remaining bandwidth. If only N video data frames are packaged into the transmission package, then (P-N) video data frames are not. A time stamp is attached to the transmission package. The time stamp expresses

20   the synchronous relationship between the video and audio data.

Through the Internet transmission channel 50, the sender Internet client transmits the transmission package 48 to the recipient Internet game client. The

25   data decoders 52 and 54 decode the transmission package 48 into real-time video data 520 to 522 and real-time audio data 540. The Internet transmission may drop some video frames, only M video frames are received (M<=N). Obviously, the number of video data

30   frames 440 to 442 is equal to or larger than the

number of video data frames 520 to 522. The video
decompression method, such as IPB mode, may also cause
video data frame drop such that only K (K<=M) video
data frames are decompressed. Audio frames 540 are
5   decompressed completely. Thus, the first package
mechanism ensures smooth audio transmission and
accurate synchronization of the video and audio data.

The video-audio playback systems 56 and 58,
display the decoded video data by simultaneous support
10 of real-time video and 3D animation, outputting real-
time video data to game environments as texture
mapping. The video-audio displayers 56 and 58, may
synchronize data by adding the system time of the
second internet game client to the time stamp and
15 generating the display time of the second real-time
video and audio data. Alternately, the video-audio
displayers 56 and 58 may display synchronized data by
comparing the time stamp to the number of frames
dropped by the second real-time video data. The data
20 synchronization can be accomplished before or after
the data has been decoded by the decoders 52 and 54.
The video-audio playback systems 56, 58, output audio
data via a sound card with audio input or output 58,
achieving real-time video-audio interaction.

25 The methods and systems provided by the present
invention can be independent from an Internet game
system by establishing an Internet transmission
channel between Internet game clients. In addition,
the invention applies the first audio data package
30 mechanism and an attached time stamp to achieve smooth

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audio transmission and accurate synchronization of the video and audio data, accomplishing real-time video-audio interaction by data synchronization in an Internet game. The invention enhances the reality of

5   the Internet game without further burdening the Internet game server, resolving problems of the existing technology.

It will be appreciated from the foregoing description that the system and method described

10 herein provide a dynamic and robust solution to real-time video-audio interaction problems. If, for example, an Internet game client changes data capture devices, the system and method of the present invention can be revised accordingly.

15 The methods and system of the present invention, or certain aspects or portions thereof, may take the form of program code (i.e., instructions) embodied in tangible media, such as floppy diskettes, CD-ROMS, hard drives, or any other machine-readable storage

20 medium, wherein, when the program code is loaded into and executed by a machine, such as a computer, the machine becomes an apparatus for practicing the invention. The methods and apparatus of the present invention may also be embodied in the form of program

25 code transmitted over some transmission medium, such as electrical wiring or cabling, through fiber optics, or via any other form of transmission, wherein, when the program code is received and loaded into and executed by a machine, such as a computer, the machine

30 becomes an apparatus for practicing the invention.

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When implemented on a general-purpose processor, the program code combines with the processor to provide a unique apparatus that operates analogously to specific logic circuits.

5   While the invention has been described by way of example and in terms of the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, it is intended to cover various modifications and similar

10   arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.